

Effect of Addition of Sugarcane Molasses in Structural Concrete

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Abstract – Now a day's, major challenges for our community is the protection of the environment from waste materials .In India alone sugarcane waste accord approx 8-10 million tones. A good solution would be the utilization of excess sugarcane molasses waste together in the final quality of concrete because it has strong potential .The use of molasses from sugarcane factory in structural concrete as alternative of chemical admixtures (water reduction admixtures). Many research papers on use of molasses has been carried out last few years. The objective of this paper is to determine the effects of structural concrete by adding of sugarcane molasses based on strength, durability, stability and economic aspects. The effects of different dosage level like 0.1, 0.2, 0.3, 0.4, 0.5, 0.6% of the molasses by weight of the cement were analyzed for the consistency, setting time, water reduction and workability. The test were performed for workability and compressive strength by adding dosage level like from 0.1% to 0.6% respectively of the molasses by weight of cement of the design mix M20, M30 and M35 for 3 day, 7 day and 28 day. The test results stipulate that molasses behave like as accelerators up to 0.5 % of dose and after that retarder. The compressive and split tensile strength of structural concrete for 3 day and 7 day with molasses indicates decline in strength. The compressive strength of structural concrete and mortar gets increased by adding 0.5 % of molasses by weight of cement for 28 day. Most favorable dosage level is 0.3 % of the molasses by weight of cement.

Key Words: Sugarcane, Molasses, Admixture for concrete, Compressive Strength, Slump, Workability.

1. INTRODUCTION

Structural concrete is most widely used material worldwide in civil engineering. It can be cast into any desired shape due to its properties, it has not only replaced the old construction like stone masonry and brick masonry but also can cast complex structures. By addition of admixtures can enhance the quality of concrete and the same time saving of the other constructional materials and make the concrete economical [1]. In situ, structural concrete production requires more skilled or experienced person for their proportioning, addition of chemicals, mixing, placing, compacting, finishing and other operations.

Molasses has been used in numerous industries as raw material like animal food industry in the production of alcohol, ferment and glycerine. Approximately, in Maharashtra 173 cooperative sugar factories is in operation which is used for the production of sugar. Adverse impact on environment comes into picture after disposing of waste materials. Thus many researchers has used the waste materials for various purposes.

Therefore, sugarcane molasses has been used like a water reducing admixtures [2]. It also makes the concrete economical instead of other admixtures but it will increase the compressive strength. Finally it will be improved the strength, durability, stability, workability and the quality of the concrete.

2. MATERIALS

2.1 Cement

43 Grade Ordinary Portland Cement (OPC) used with trade name of Ultratech Cement conforming to IS: 12269 – 1987[3] having Specific gravity- 3.15 has been used.

2.2 Fine Aggregates

Fine aggregates have been taken from local sources. Its specific gravity is 2.69 had taken. Aggregates most of which passes through 4.75 mm IS sieve had used. Sand conforms of IS 383-1970 [4]. Table-1 shows the property of fine aggregates.

Table-1: Property of Fine Aggregate

Sr. No.	Parameters	Results
1.	Material finer than 75 μ	19.42%
2.	Specific gravity	2.69
3.	Fineness modulus	2.89
4.	Bulk density	1.78 Kg/lit.
5.	Water absorption	2.90%

2.3 Coarse Aggregates

Locally available coarse aggregates have been used. The size of coarse aggregates is 20mm used. Its specific gravity 2.89 has been taken. Table-2 shows the property of coarse aggregates.

Table-2: Property of Coarse aggregates

Sr. No.	Parameters	Test result
1.	Specific gravity	2.89
2.	Elongation index	16.88%
3.	Flakiness index	10.78%
4.	Aggregates crushing value	11.66%
5.	Aggregates impact value	4.76%
6.	Bulk density	1.49 Kg/lit.
7.	Water absorption	0.55%

2.4 Water

Water is important parameter of concrete, and its chemical reaction occurs with cement. Normal tap water means drinking water used for all purposes as per IS 456:2000 [5].

2.5 Admixtures

Molasses is a water reducing admixtures, brownish black in colour and completely soluble in water. In this work the molasses was taken from ShadiLal Enterprises Limited (SSEL), Shamli, Uttar Pradesh. Sample is given in chart 1.

Table-3 shows the chemical analysis and contents of molasses.

Table-3: Chemical Content of Molasses

S. No.	Contents	Results (%)
1.	Water as Moisture	25.0
2.	Chloride Content	1.25
3.	Sulphate (SO ₄)	2.5
4.	Nitrogen content	0.77
5.	Total Solids	79.0
6.	Ash	8.66
7.	Sucrose	39.99
8.	Total reducing Sugar	58.95
9.	Apparent Purity	49.89



Chart-1: Sample of Molasses

3. METHODOLOGY

3.1 Workability

Workability is defined as the ease and homogeneity with which the mixed concrete or mortar can be placed, mixed, compacted and finished. Workability is accomplished with ease of flow, prevention of segregation, harshness, and bleeding. The degree of workability is measured by slump value of concrete. According to IS-1199:1959 [6] test was carried out. The effect of different molasses dose on slump is followed in table- 4

Table-4: Effect of different dose of molasses on slump value

S. No.	Molasses dosage (%)	Slump (cm)
1	0.1	4.9
2	0.2	5.7
3	0.3	7.1
4	0.4	9.3
5	0.5	16.7
6	0.6	18.6

3.2 Compressive Strength

Compressive strength of concrete were carried out according to IS-10086:1982 [7] and three cubes specimen taken 15x15x15 cm of size. It was tested at the age of 7 days, 14 days and 28 days as per given specifications in IS-516:1959 [8]. Specimens curing were taken for period of 7 days, 14 days and 28 days respectively and allowed for drying. One by one sample kept properly in 200 ton

capacity compressive testing machine. Applied the load gradually and ultimate load were recorded. Compressive Strength of Various Mixtures at Various doses of Molasses given in table-5.

Table-5: Strength of Mixes at various dose of Molasses

S. No	Mix Design	Dosage of molasses (%)	Compressive strength (MPa)		
			3 day	7 day	28 day
1	M20	0.1	11.44	16.41	24.98
		0.2	12.98	17.88	25.99
		0.3	13.00	18.76	26.86
		0.4	13.65	19.87	25.09
		0.5	10.74	15.54	24.99
		0.6	9.68	15.34	19.22
2	M30	0.1	17.70	22.88	34.96
		0.2	16.79	23.96	35.55
		0.3	18.41	25.01	37.21
		0.4	17.32	26.80	36.65
		0.5	14.53	23.05	33.54
		0.6	12.03	16.78	33.91
3	M35	0.1	17.23	25.08	39.15
		0.2	18.22	26.98	40.87
		0.3	19.70	27.30	41.50
		0.4	16.31	28.80	37.56
		0.5	16.98	24.96	38.87
		0.6	11.91	22.05	38.02

4. RESULTS AND DISCUSSION

4.1 The Slump Test

The slump test has been used to determine the workability of concrete as shown in chart 2. The slump value decreases as the dosage of molasses decreases. This is due to the retarding property of molasses. Adding molasses to the concrete raises the slump values. It signifies that the workability of a concrete mix improves significantly.

The graph of slump at various dosage of molasses was plotted for all the mix design as shown in chart 2.

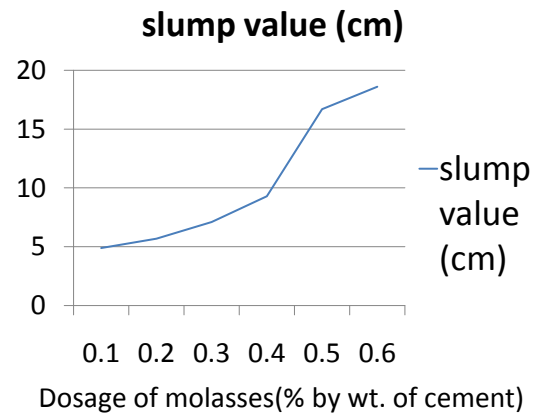


Chart-2: Slump Value (cm)

Based on the observations obtained, it was noted below-

Because the behaviour of concrete with dosage of molasses is investigated in this study, which results significantly increase in the workability.

It could be due to the sucrose in the molasses forming a viscous gel that traps the air inside the concrete mix and acts as a lubricant, that improves the rating of the workability.

If we use a specific slump value as a regulating factor, the W/C ratio required may decrease with dosage of molasses in a controlled manner.

4.2 Compressive Strength Test

As per IS: 9103-1999 [9]. If the concrete prepared has a 12% increase in compressive strength, the admixture employed can be classified as a water reducing admixture. In chart 3, the compressive strength of concrete cubes with various molasses dosages is shown. The result shows that compressive strength does not change linearly with dosage of molasses.

The graph of compressive strength at various dosage of molasses was plotted for all the mixes as shown in chart 3.

Compressive Strength Vs % of Molasses Graph

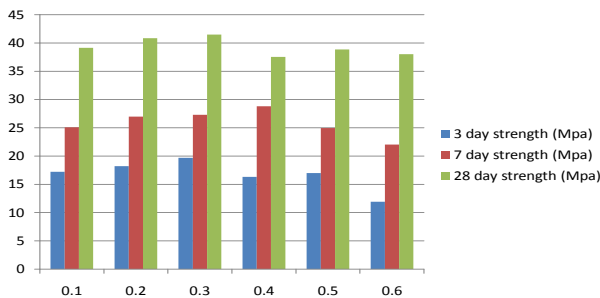


Chart-3: Compressive Strength Results for M35 Design Mix.

Based on the observations obtained, it was noted below,

For 3 day strength, all three mixes of sample showed a decline in the value of compressive strength, based on the observations made. It's possible that this is due to the beginning of the production of sucrose gel with water in the concrete.

For 7 day strength, it indicates that a higher level of molasses in the concrete mix causes the hardening process to take longer. For each blend the best results were found at 0.30% dosage of molasses.

For 28-day strength, up to 0.30% molasses dose resulted in increases in the value of concrete compressive strength for each sample of mixes. However, as the molasses dosage was increased beyond 0.30 percent, compressive strength was seen to decrease when compared to the control sample.

The pattern was nearly identical for each mix. The value of compressive strength decreased after three days. There was a decline in compressive strength after seven days. At 0.30% molasses dosage, there was a rise in compressive strength at 28 days, but beyond that, there was a loss in compressive strength.

5. CONCLUSIONS

The following conclusions can be formed based on the experimental data produced in this work, revealing the influence of sugarcane molasses addition in structural concrete, cement and cement mortar at various dose of molasses levels.

- Molasses includes approximately 18% to 22% sugar.
- Molasses works as an accelerating agent at small amount and as a retarding agent at large amount. As a result, the setting time of cement paste with varied percentage of molasses show significant differences. It operates as an accelerating agent up to 0.5% dose and as a retarder at higher percentage.

- Molasses is a water reducing additive that can reduce water by up to 10% when used at 0.5% dose of molasses by weight of cement.
- In the region of 0% to 0.5% dosage level, the relation between dosage level of molasses and percentage reduction of water for the same workability nearly linear.
- For each mix, the rate of water decrease varies. It's the highest for a poor mix and the lowest for a wealthy one.
- As the molasses dose level was increased, the slump value increased, suggesting that the concrete became more workable.
- The 7-day compressive strength of various cement mortar mixes drops when the dosage amount is raised. However, the strength at 28 days is considerable in the range of 0% to 0.5% of the dosage level of molasses.

6. REFERENCES

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